# The trajectories of EAEC countries development: Numerical analysis of competitive strategies in investments

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A. G. Shelomentsev, M. A. Medvedev, K. F. Isaichik, M. I. Dyomina, I. A. Berg, and M. Kit

# The trajectories of EAEC Countries Development: Numerical Analysis of Competitive Strategies in Investments

A. G. Shelomentsev[1, a)], M.A. Medvedev[2,b)], K.F. Isaichik[2, c)], M.I. Dyomina [2, d)], I.A. Berg[2,e)], M. Kit[3,f)]

[1] *Financial University under the Government of the Russian Federation, Ufa branch, 450015, 69/1 Mustai Karim str., Ufa, Russia*
[2] *Ural Federal University, 620002, 19 Mira str., Yekaterinburg, Russia*
[3] *Language Interface Inc., 98174, 1200 Western ave., Seattle, USA*
a) Corresponding author: chel61@mail.ru
b) medvedevmaa@gmail.com
c) k-isaichik@mail.ru
d) dyominamariya@mail.ru
e) berg77777@gmail.com
f) clodpool@gmail.com

**Abstract.** This paper discusses comparative analysis of trajectories in the development of participating countries of the Eurasian Economic Union (EAEC) in a two-dimensional phase space. The coordinates in the space is represented by the value of a dynamic variable that is a key indicator of the country's development, and the rate of its relative growth. This allows for construction of a ternary classification diagram describing competitive behavior strategies of countries in question. The comparative analysis was run for two primary factors: the size of investment in the main capital and R&D spendings. The authors carried out analysis and identification of competitive strategies for the behavior of the EAEC countries, as well as he proposed conclusions and recommendations on improving the policy of economic development.
**Keywords:** comparative analysis, EAEC countries, strategies of competitive behavior, phase space.
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## INTRODUCTION. TYPOLOGY OF STRATEGIES FOR ECONOMIC GROWTH OF NATIONAL ECONOMIES

As international practices show, the pace of economic development is influenced by a wide range of economic, institutional, financial, investment, and other factors, which is covered in a large number of publications. Comparative numerical analysis of trajectories of countries' development can help choose efficient economic policy in the world's competitive environment [1]. Such analysis can be carried employing different ways of classification where the most common technique is the cluster analysis and which also include the method of committees [2], the morphological analysis [3] and other methods. In this study, the problem of classification is solved through the method based on construction a triple-component phase diagram. Classification of behavioral strategies of communities was suggested in the article [4] and was later applied to the description of competitive behavior of economic agents [5, 6]. This technique can be used in the analysis of time series obtained through statistical data processing or mathematical modeling, e.g., using agent-based models [7, 8].

The object of this study is a number of states of the Eurasian Economic Union (EAEC) - Russia, Kazakhstan, Belarus, Armenia and Kyrgyzstan. The diversity of national strategies and models of their implementation translates into a multi-dimensional space of opportunities to choose from. The two problems the EAEC countries face in the course of reindustrialization in order to reduce the backlog and ensure a forced transition to the 5th (with elements of the 6th) technological structure, are a) the relative reduction in price of the resource base; b) production facilities upgrading and modernization of the manufacturing industry [9]. These priorities have allowed to identify three types of primary strategies for economic growth

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of national economies in line with specific conditions, as well as a set of specific factors: *competitors C* ("violents", lions / hippos / elephants, " leaders in cost "), whose behavioral models are characterized by the availability of effective mechanisms that ensure access to resources and production intensification; *Stress-tolerants* S ("patients", foxes, "niche players"), with slow rates of development due to significant lack of resources; "*ruderals*" (R) ("explerents", swallows, "skimers the cream off") that seeking to maximize revenues (income) inflow to the budget in a weak international competition and significant resources, The past efficiency is of secondary importance. It should be noted that in practice countries with secondary strategies prevail.

The dataset for the study was made of World Bank's statistical data for the EAEC countries and the data obtained from official statistics of these countries.

## METHODS FOR IDENTIFICATION OF COMPETITIVE BEHAVIOR STRATEGIES

Methods for identification of strategies of competitive behavior of economic agents use a ternary phase diagram depicted on a plane (Figure 1). The classification diagram is a field of relative index values (Ic - competition index; Is - stress index; Id – disturbance index) where each value is responsible for the affiliation to the respective primary strategy. Thus, agents with primary strategies are located at the corners (R, S, or C), and field triangle is divided into four secondary types between which possible transitions lie.

When constructing a chart by its axes, two of the three main indices are postponed (Figure 1). The third index is always dependent, because the agent uses all its capabilities and efforts to resist the three main types of external influence – stress, disturbances and competitors (respectively S-, R-, C - strategies). Assuming that the value of the total amount of these conditions is 100%, the following equation can be written:

$$I_s + I_R + I_c = 100\%,$$

where "I" is the intensity of efforts required to implement the relevant (S, R, C) strategies agent's behavior.

To move from the model to practical methods of identifying strategies, it is necessary to find the corresponding measurable characteristics of the agents. Thus, it becomes possible to identify competing behavior strategies from empirical data based on only two independent parameters.

When the classification diagram is constructed as a competition index (left oblique axis) used absolute value some economic parameter *M*, and as a stress index (the horizontal axis) – its relative growth *M',* which is calculated by the formula*:*

$$M_i^{'} = 100(M_i - M_{i-1})/M_{i-1}.$$

The scale of the diagram is set based on a range of values *M* и *M'* initial data. Marking lines are held parallel to the axis: on the left-inclined held parallel to the horizontal, and on the horizontal - parallel to the left-inclined.

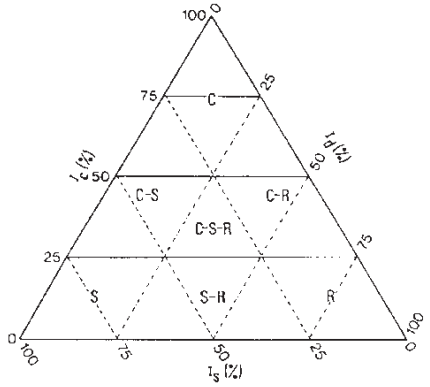


**FIGURE 1.** The classification diagram of competitive strategies of agent behavior, quantitatively characterizing the contribution of each of the basic strategies R, S, C types.

Making this diagram requires to calculate the indices M and M□ using economic data. Postponing the obtained values on the corresponding axes of the diagram, at the intersection of these values, we get the location of the object on the diagram. Similarly, it is possible to build a dynamic diagram using data for one object at different times.

When calculating by the identification method, countries are grouped according to the types of strategies. It does not matter, considering each individual country as a separate species, or a set of a number of countries as a

representative of one type of economic agents. If we consider the country as one type of economic agents, competition and stress due to a shortage of resources for individual countries will always be inevitable due to the almost complete overlapping of economic niches.

## THE ANALYSIS AND IDENTIFICATION OF COMPETITIVE BEHAVIOR STRATEGIES EAEC COUNTRIES

Figure 2 shows the graphs that characterize each of the strategies (a-S strategy, b-R strategy, c-C strategy) depending on time, which are based on the amount of investment in fixed capital per capita from 2005 to 2015 in Different countries. From the presented graphs, it is clear that Armenia and Kyrgyzstan proportion C strategy in the total amount for the whole time does not exceed 20%. This indicates that these countries adhere to the R-S strategy and adapt to unproductive, non-equilibrium markets. The rest of the countries for almost all 10 years adhere to the C-S-R strategy, it means, they have been adapted to the markets where the intensity of competition and the uneven-market condition of the market are due to medium-intensity stress and disturbance.

Figure 3 shows: the static diagram of investment in fixed capital per capita for 2014 - 2015 (a), the dynamic diagram for the period from 2005 to 2015 (b) and, for clarity, the dynamic diagram of the trajectory beams of Armenia and Russia (c).

The static diagram allows us to evaluate the ratio of strategies at a time, and the general dynamic diagram allows us to observe the change in the strategies of countries in the period from 2005 to 2015. Analyzing the data of the presented diagram, it is clear that Armenia and Kyrgyzstan for 10 years adhere to a similar and practically unchanged strategy, while Russia and the EAE during the period from 2005 to 2015 have constantly changed their strategy. Figure 3 shows the graphs of the values of each of the strategies (a-S strategy, b-R strategy, c-C strategy) depending on time, which is based on the countries' internal research and development costs for the period from 2005 to 2014.


**FIGURE 2.** Time series of the values of the contribution of each of the basic strategies to the competitive behavior of the EEA countries in the sphere of investment in fixed assets per capita in the period from 2005 to 2015: a) S strategy; B) R strategy; C) C strategy.

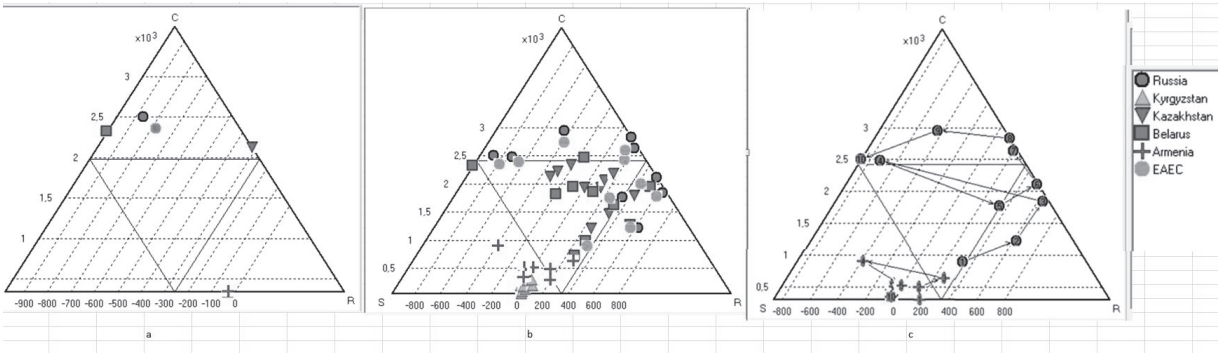


**FIGURE 3.** Classification diagrams of investments of the EEA countries into fixed capital per capita: a) static diagram for 2014 b) dynamic diagram for the period from 2005 to 2014 c) dynamic diagram for Russia and Armenia with the trajectory of strategy changes in the period from 2005 to 2015.

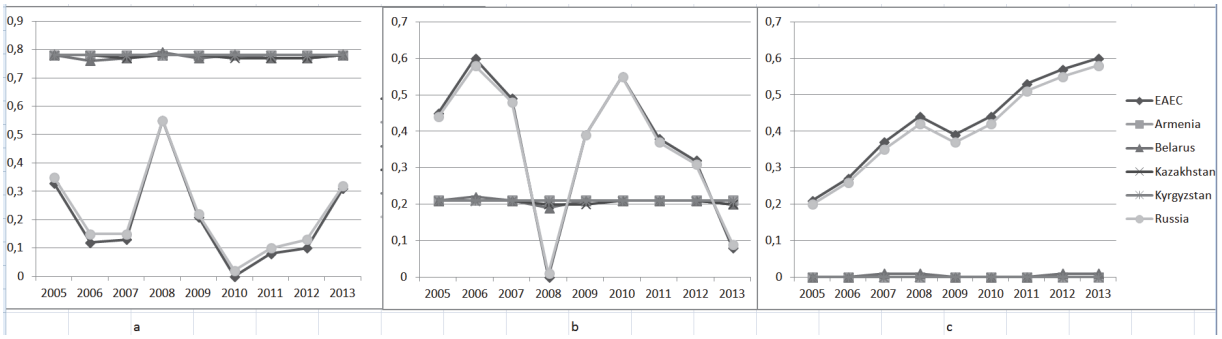


**FIGURE 4.** Time series of the values of the contribution of each of the basic strategies to the competitive behavior of the EEA countries in the field of investment in research in the period from 2005 to 2014: a) S strategy; b) R strategy; c) C strategy.

From these graphs, it is clear that Russia and the EAEC follow to C-S-R, but only in 2008, when there was a crisis, observed clear C-S strategy, share R strategy equal zero. Other countries clearly expressed S strategy, as the share of C strategy is zero, and R strategy is about 20%.

Figure 4 shows: static diagram of internal cost countries for scientific research and development in 2013- 2014 (a), dynamic diagram in the period from 2005 to 2014 (b) and dynamic diagram beams Belarus and EAEC trajectories (c). Analyzing the presented data on the diagram shows, that all countries, except Russia and EAEC adhered to one strategy all the time. Wherein, randomly arranged elements, symbolizing Russia and EAEC, indicate a change in strategy during this time.

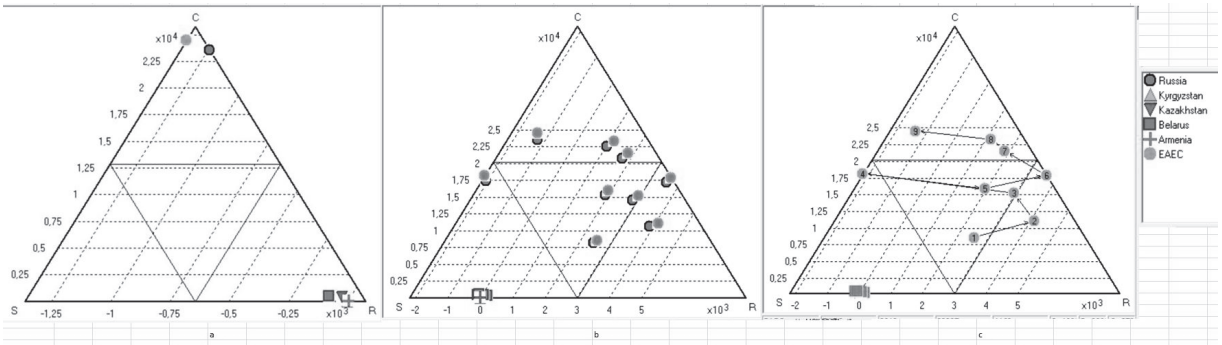


**FIGURE 5.** Classification diagrams of domestic costs of countries for research and development: a) a static chart for 2013 b) a dynamic diagram for the period from 2005 to 2014 c) a dynamic diagram for Belarus and the EEA countries with the trajectory of changing strategies for the period from 2005 to 2014.

## CONCLUSIONS AND RECOMMENDATIONS ON IMPROVING THE ECONOMIC DEVELOPMENT POLICY OF EAEC COUNTRIES

Thus, the analysis and the identification of competitive strategies of the EAEU countries allowed us to draw some conclusions. Firstly, the relationship between selected factors and economic development EAEC countries is much more complicated than is usually presented in the scientific literature. This is due to the fact that the effect of these factors is mediated by the simultaneous presence of a wide range of other processes and conditions. At the same time an important role played by existing institutes in a particular country, the effectiveness of which can greatly affect the results of direct investment and effectiveness of R&D. Secondly, the same factor (for example, foreign investment or R & D expenditures) differently manifested in the economies of various countries. A universal approach is not working. In this sense, the problem is not only to attract more investments, but to create conditions, under which they will provide the greatest effect for the development of national economy and its updates. Thirdly, as practice shows, the role of analyzed factors over time may vary considerably. In this respect, the stability of the national economy is manifested in the stability of the existing trends in the dynamics of its development.

## ACKNOWLEDGMENT

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